



Update on Dijet Resonances in Dijet Mass at 7 TeV

Sertac Ozturk (Cukurova University / LPC)

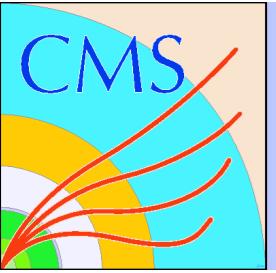
Robert M. Harris, Konstantinos Kousouris, Kalanand Mishra (Fermilab)

Shabnam Jabeen (Brown University)

Chiyoung Jeoung, Sung-Won Lee (Texas Tech University)

Kai Yi (Iowa University)

Marek Zielinski (Rochester University)



Outline

- Dijet Mass Distribution and QCD
- Dijet Mass Distribution and Fit
- High Mass Event
- Early Limit on Dijet Resonances
- Conclusion



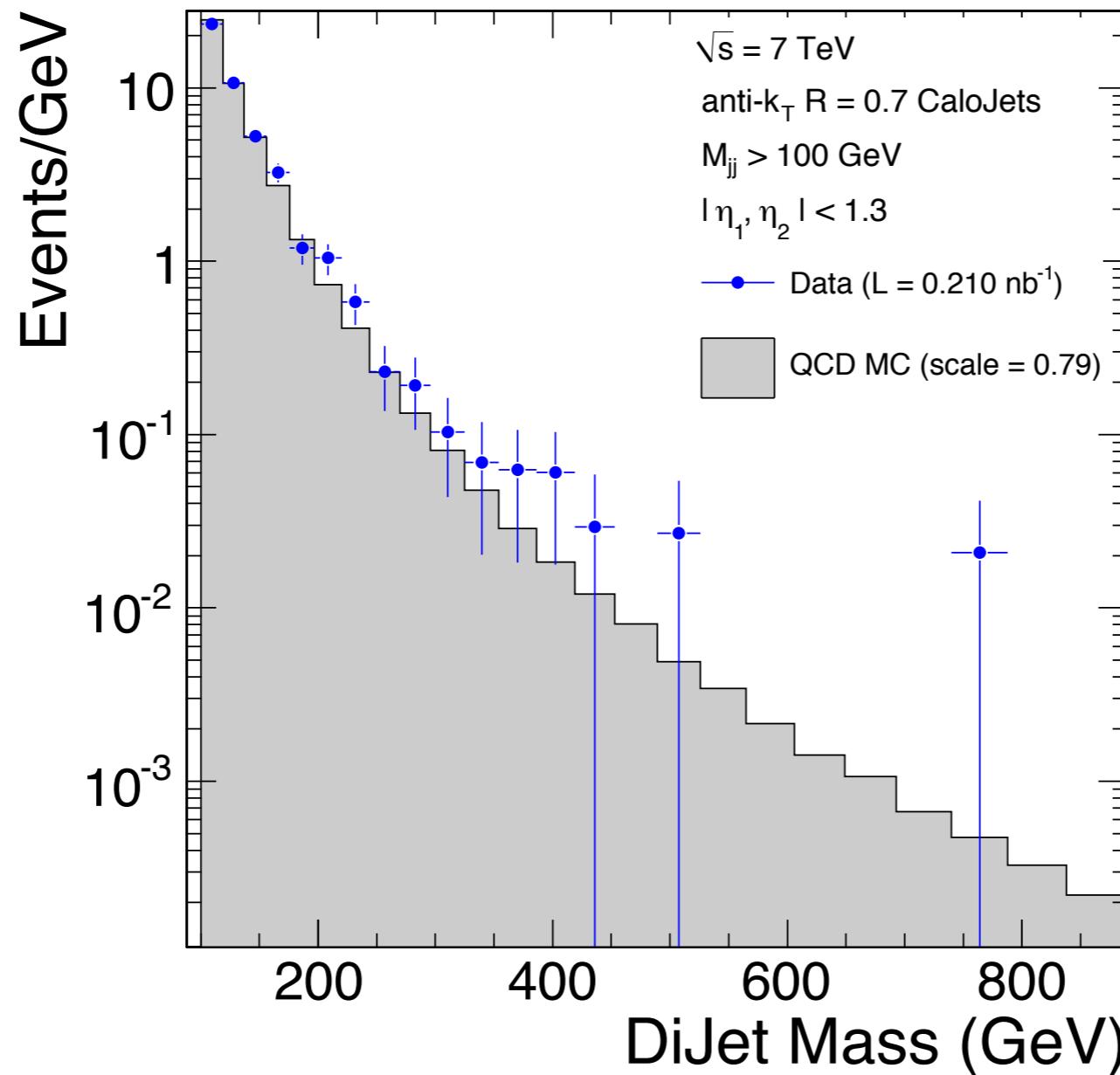
Event Selection

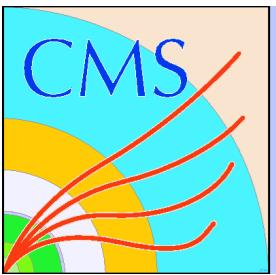
- Dataset
 - ✓ /MinimumBias/Commissioning10-PromptReco-v8/RECO
 - ✓ Run:
I32599, I32601, I32602, I32605, I32606, I32645-I32648, I32650-I32654, I32656, I32658-I32661
, I32958-I32961, I32965, I33034, I33035, I33036, I33038, I33046, I33158, I33161, I33320, I33321
, I33324, I33336, I33446, I33448, I33450
 - ✓ Trigger bits: '0 AND (40 OR 41) AND NOT (36 OR 37 OR 38 OR 39) & HLT_PhysicsDeclared
 - ✓ Scrapping event removal
 - ✓ Estimated Luminosity: 0.21 nb^{-1} (with 10-15% error)
- Event Selection
 - ✓ AK7caloJets
 - ✓ JEC: L2+L3, "Summer09_7TeV_ReReco332"
 - ✓ Preselection: only jets with raw $\text{pt} > 3 \text{ GeV}$ & $M_{jj} > 30 \text{ GeV}$ (corrected)
 - ✓ $|\text{PV}_z| < 15 \text{ cm} \&& \text{PVndof} \geq 4$
 - ✓ Both $|\text{jet } \eta| < 1.3$
 - ✓ Both leading jets passing the "loose" jet id & $M_{jj} > 100 \text{ GeV}$ (corrected)
- Total: 889 Dijet Events (loose JetID cut rejected only 1 event)



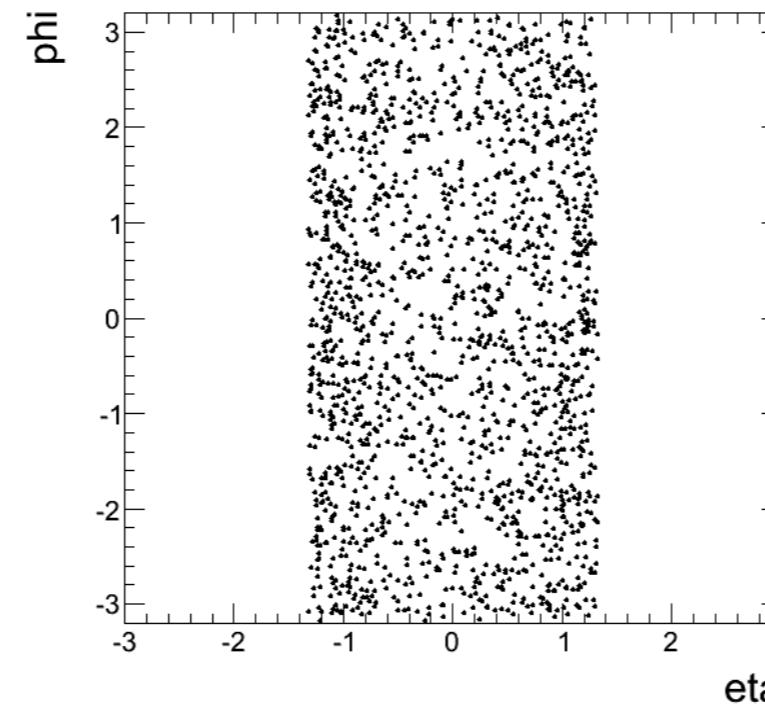
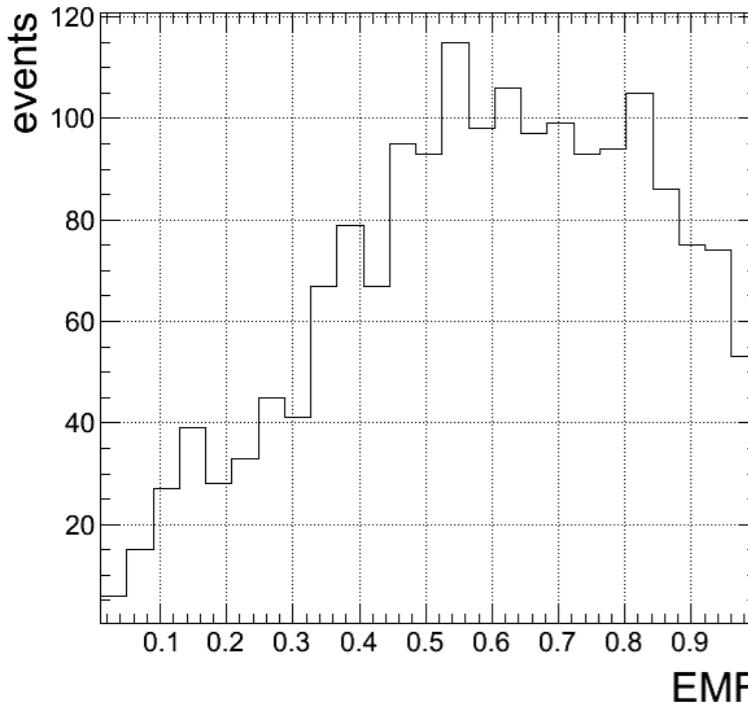
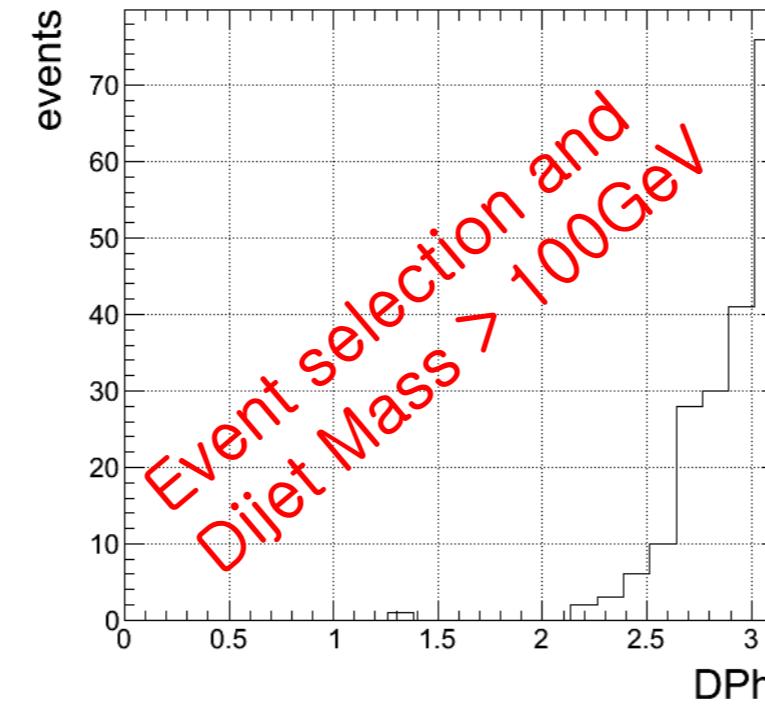
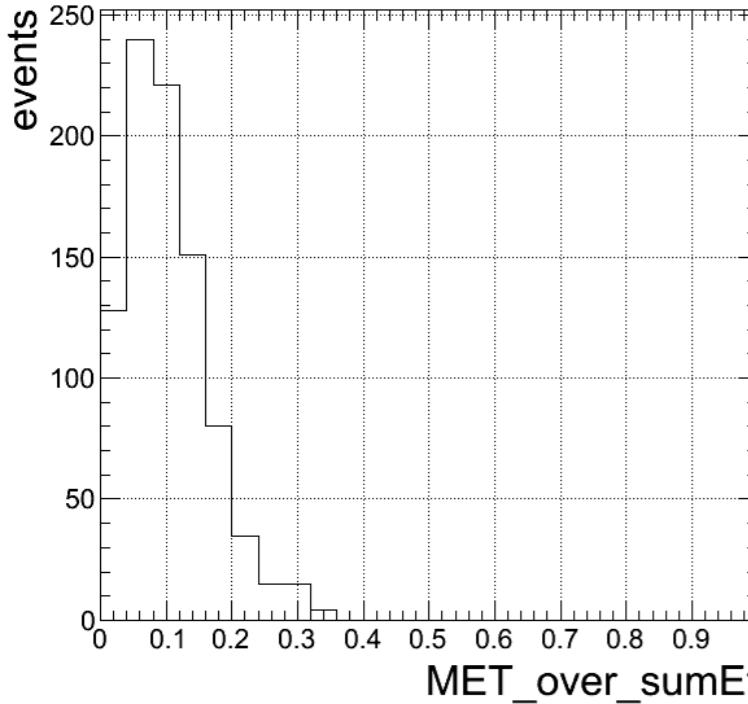
Dijet Mass and QCD

- The shape of the PYTHIA QCD MC prediction is close to the data.





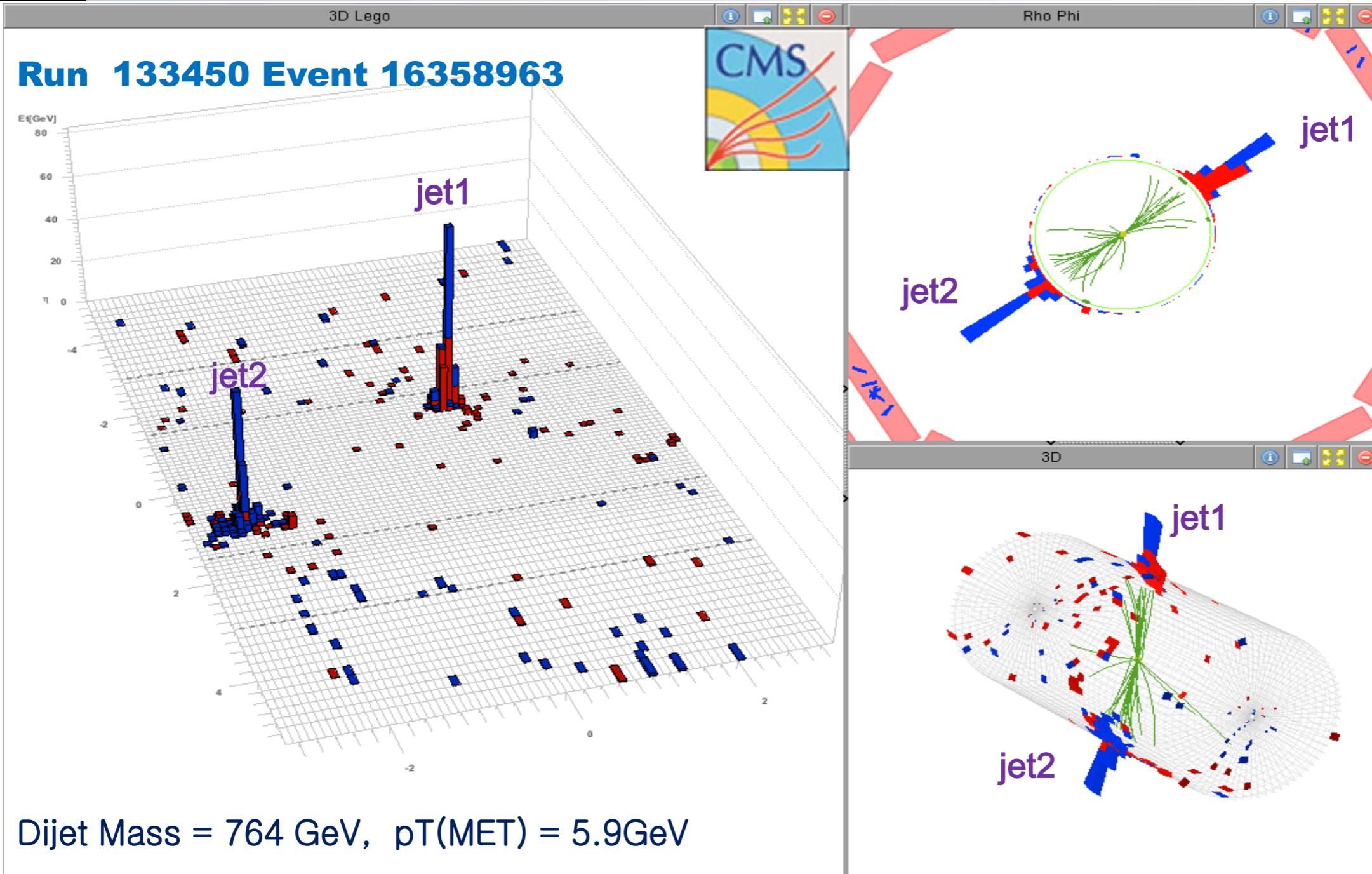
Basic Jet Distributions



- Basic jet distributions look good.
 - ✓ Low MET
 - ✓ Back-to-Back in phi
 - ✓ No spike in EMF distribution
 - ✓ η - ϕ is uniform



High Mass Dijet Event



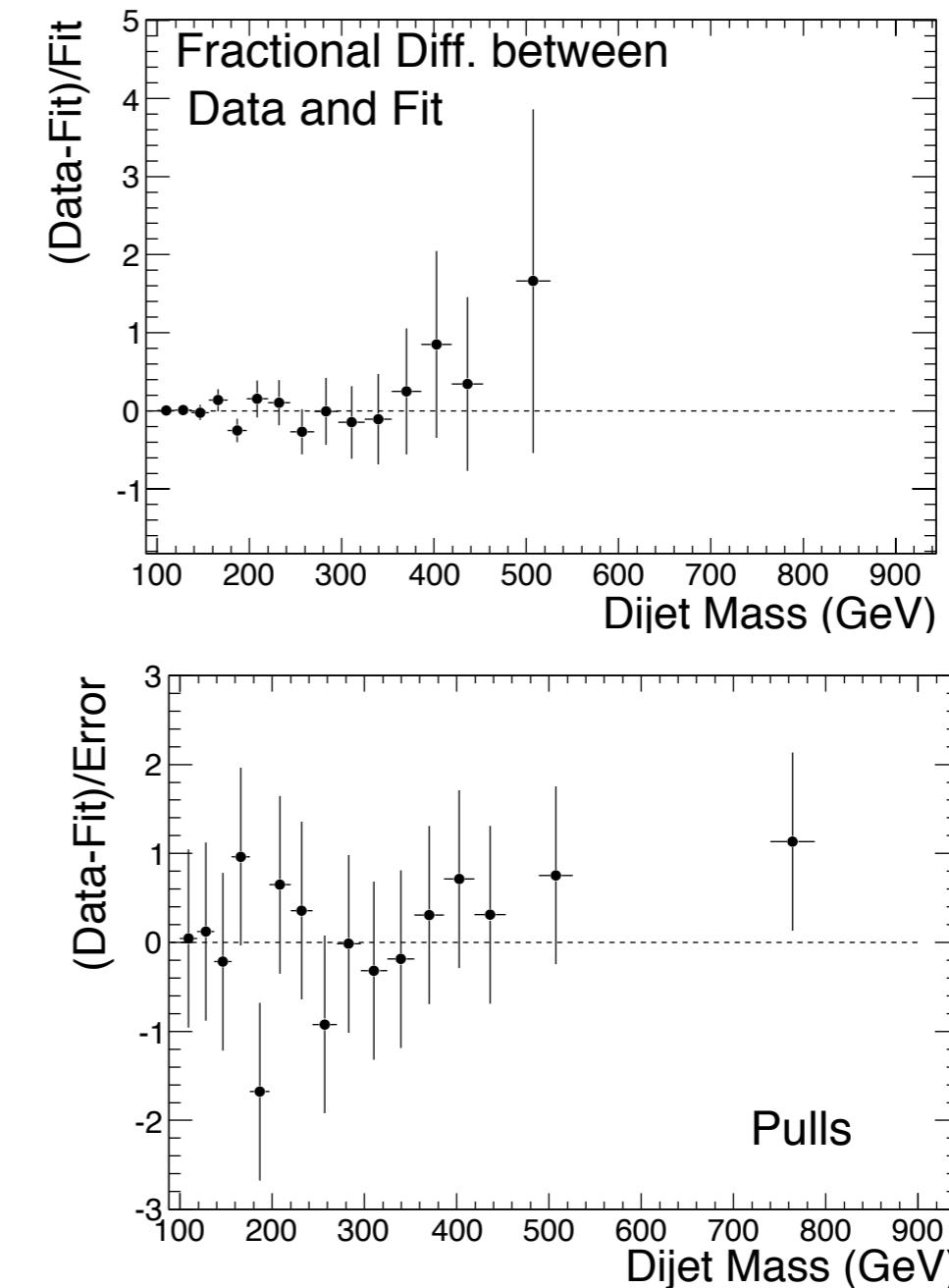
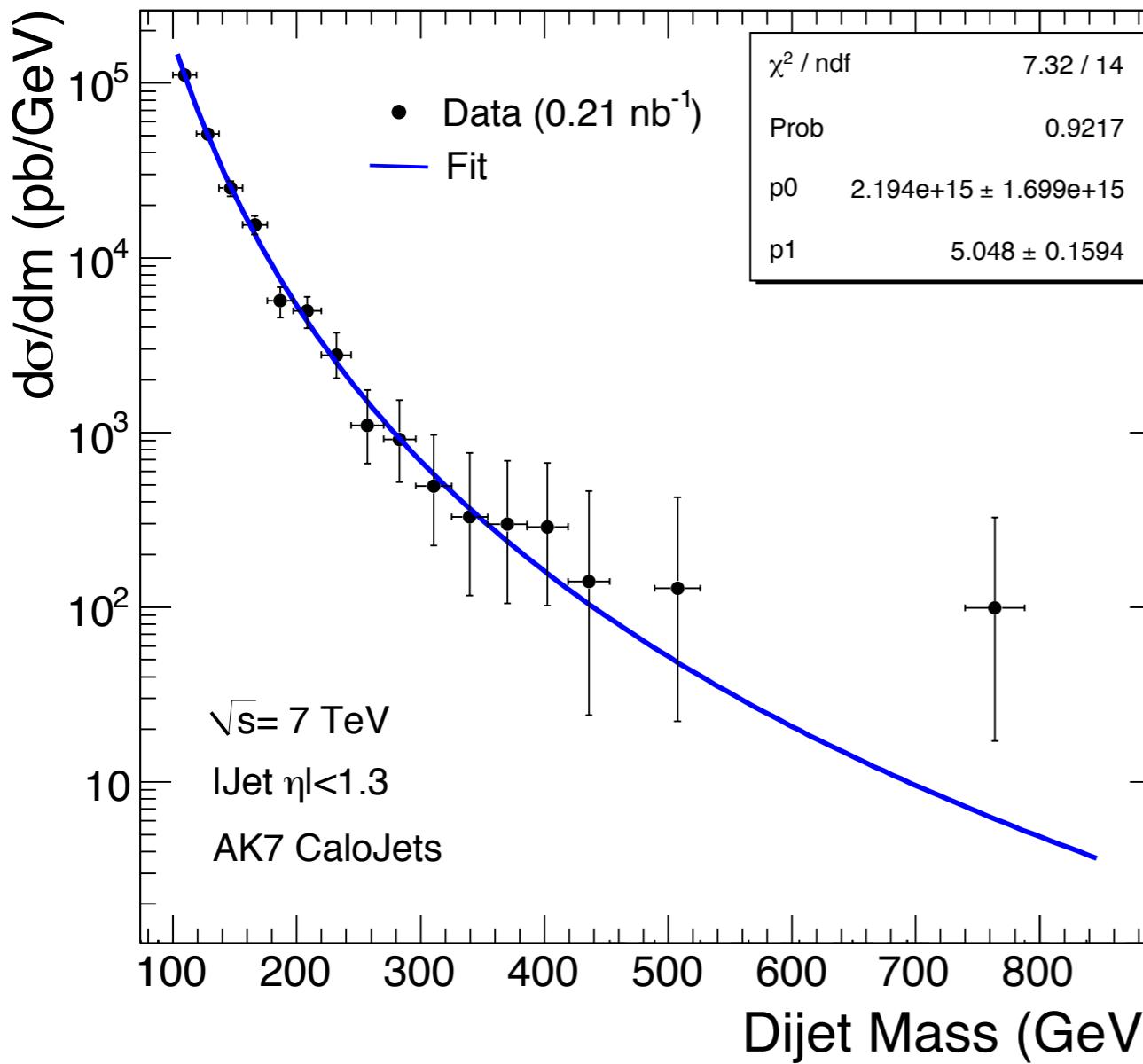
Jets	CorP _T (GeV)	η	Φ	n90hits	n90	emf	nTrkCalo	fHPD	fRBX	met/sumet
Jet1	253	-1.1	0.6	64	10	0.61	10	0.27	0.35	0.01
Jet2	244	0.9	-2.5	60	26	0.30	14	0.38	0.58	5

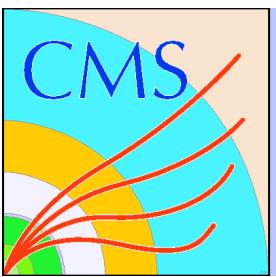


Dijet Mass and Fit

- We fit the data with the function with

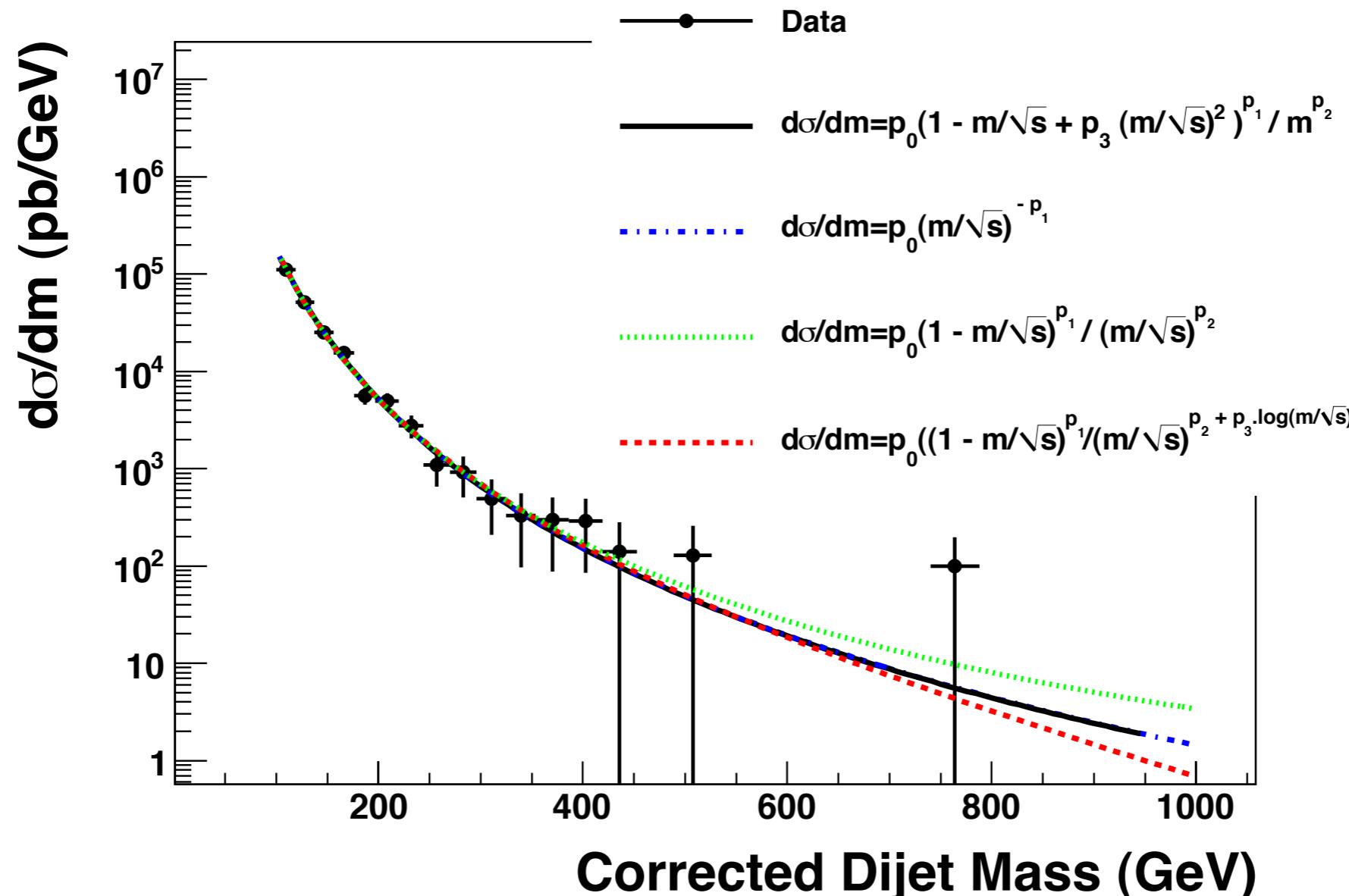
$$\frac{d\sigma}{dm} = \frac{P_0}{m^{P_1}}$$

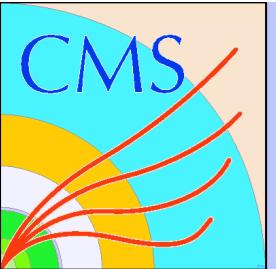




Alternate Fit Parametrization

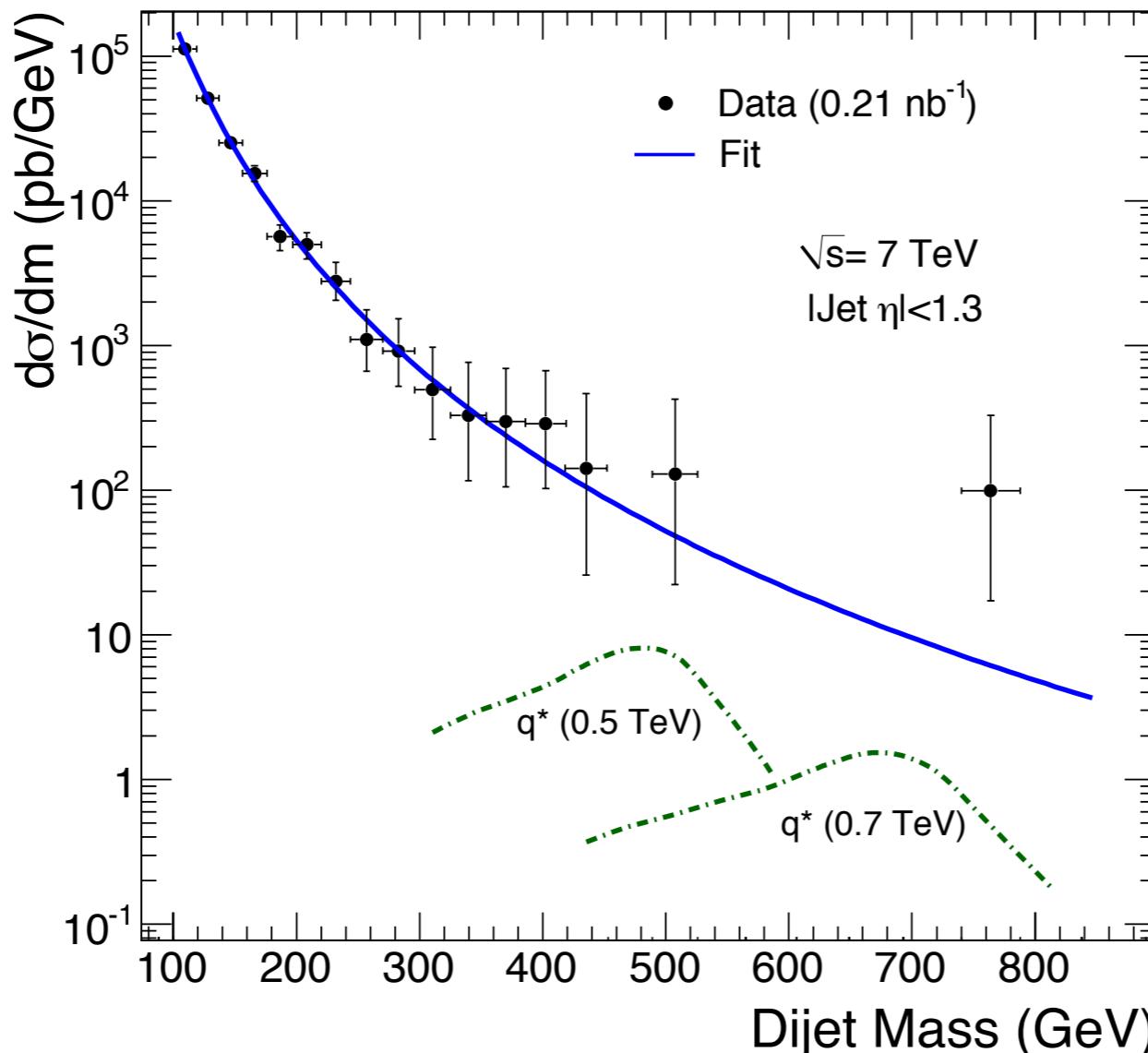
- More complex parametrizations have been tried, but they are not needed yet.
- With current low mass and low mass statistics data they give similar fits.

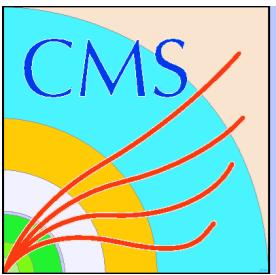




Fit and Signal

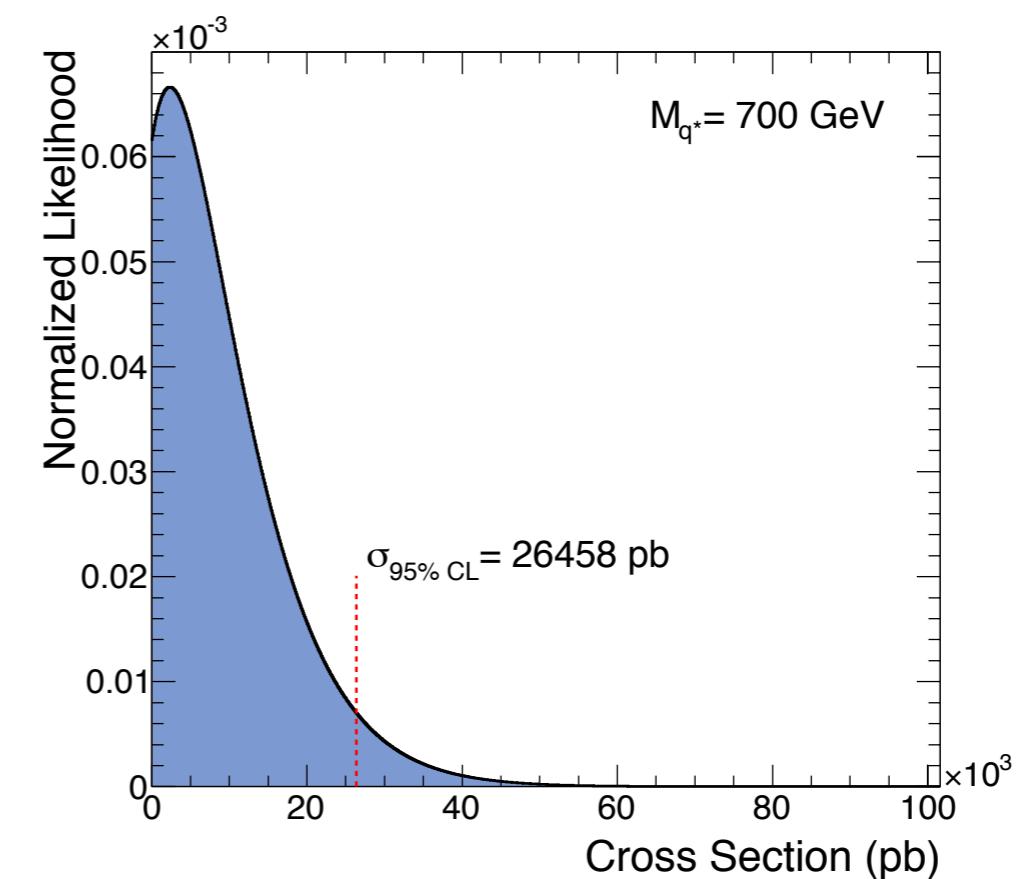
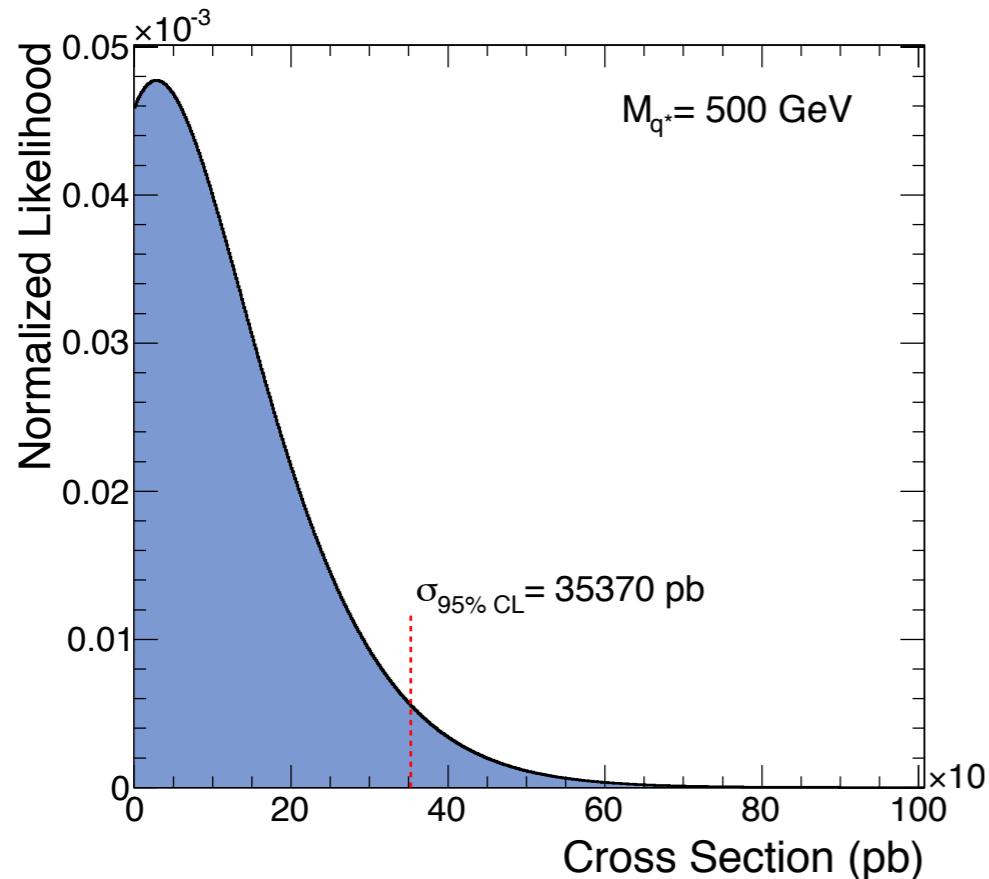
- We search for excited quark signal in our data.
- Excited quark signals are shown at 0.5 TeV and 0.7 TeV.



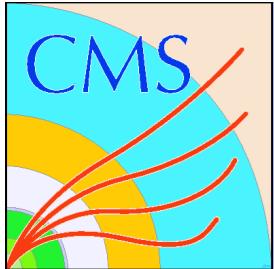


Likelihood with Statistical Error

- Likelihood distributions as function of signal cross section for different resonance mass are shown.
- 95% C.L. upper limit on cross section calculated.

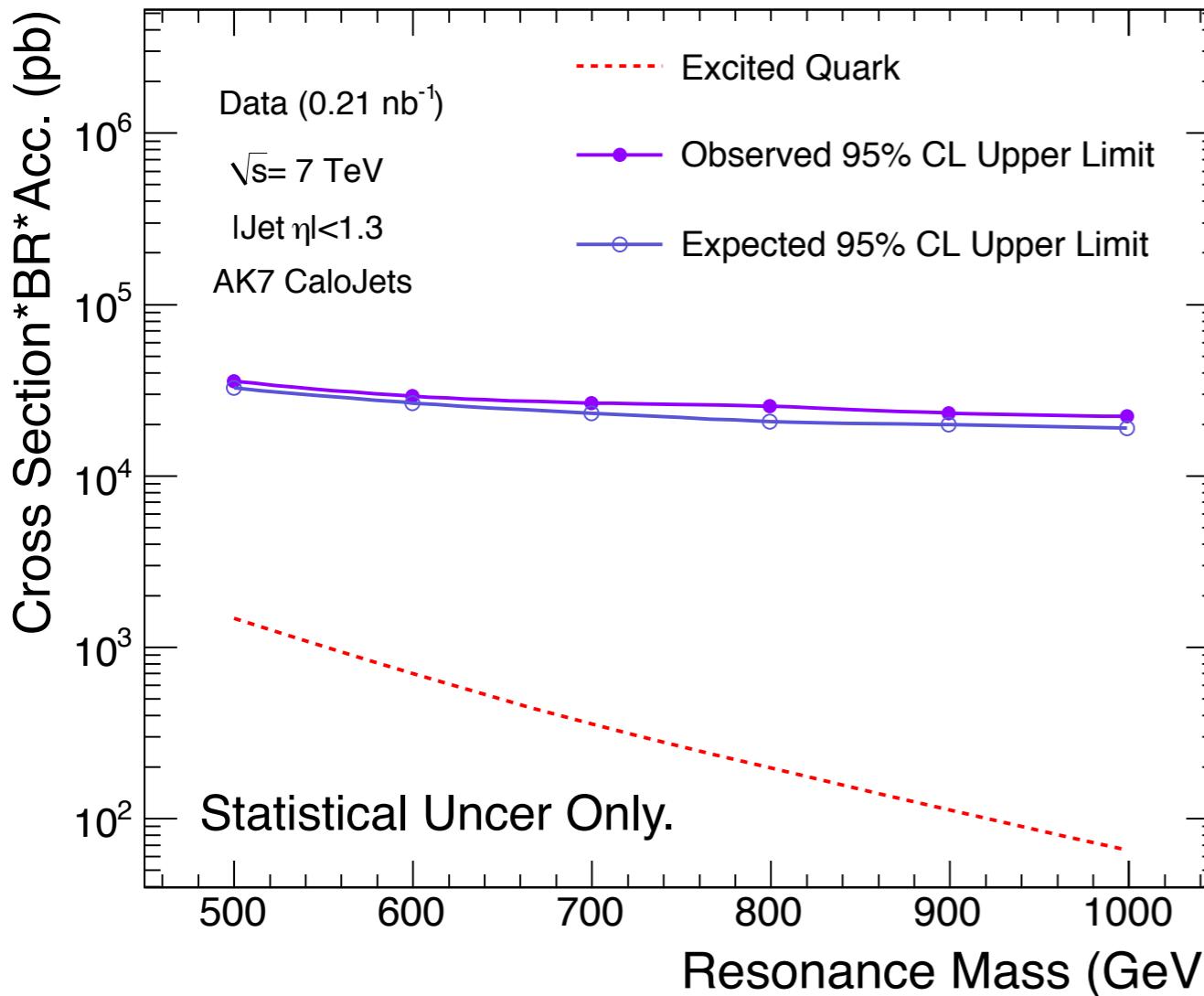


$$\frac{\int_0^{\sigma_{95}} L(\sigma) d\sigma}{\int_0^{\infty} L(\sigma) d\sigma} = 0.95$$

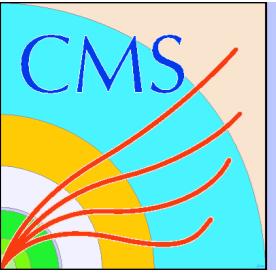


Early Limits with Statistical Uncertainties Only

- We have a look early limit in the data.
- 95% C.L. upper limit at high mass is roughly what we expect for a single observed event at 760 GeV
- ✓ $(4.74 \text{ events})/(0.21 \text{ nb}^{-1}) = 23 \times 10^3 \text{ pb}$ is what we expect if we did not subtract background



Mass (TeV)	95% CL Upper Limit (pb)	
	Observed	Expected
0.5	35370	32091
0.6	28597	26470
0.7	26458	23019
0.8	25135	20763
0.9	22862	19468
I	21903	18953

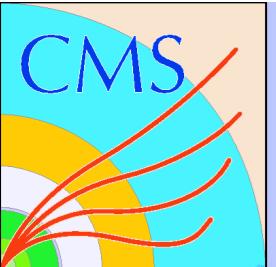


Conclusion

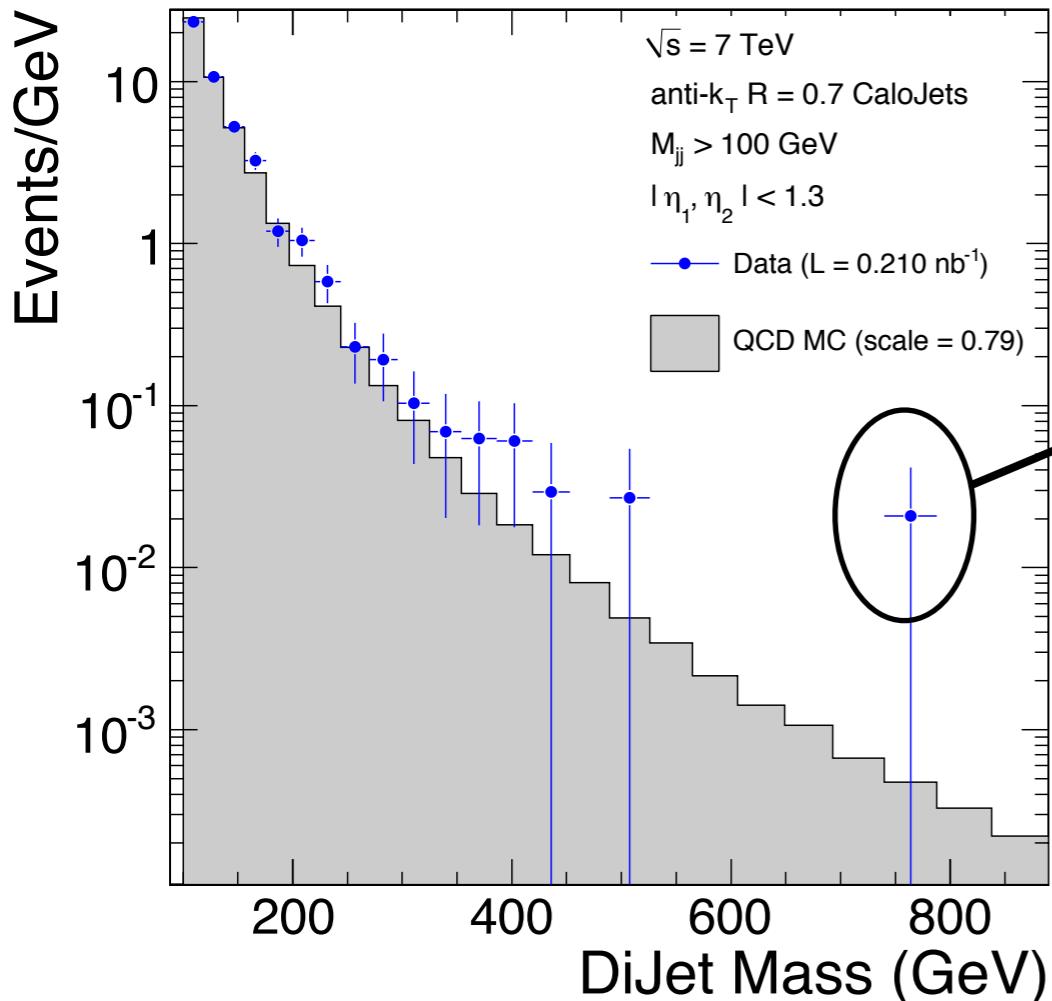
- We have a dijet mass spectrum that extends to 760 GeV
- The dijet mass data is in reasonable agreement with the PYTHIA MC prediction
- The data is well fit by a simple power law.
- Our machinery to set upper limit on dijet resonance cross section work and gives reasonable results.
- We eagerly await $\sim 1 \text{ pb}^{-1}$ of data which should give us better q^* limits than Tevatron.



Back-Up Slides



Comparison Limits



n	$1 - \alpha = 90\%$		$1 - \alpha = 95\%$	
	ν_{lo}	ν_{up}	ν_{lo}	ν_{up}
0	—	2.30	—	3.00
1	0.105	3.89	0.051	4.74
2	0.532	5.32	0.355	6.30
3	1.10	6.68	0.818	7.75
4	1.74	7.99	1.37	9.15
5	2.43	9.27	1.97	10.51
6	3.15	10.53	2.61	11.84
7	3.89	11.77	3.29	13.15
8	4.66	12.99	3.98	14.43
9	5.43	14.21	4.70	15.71
10	6.22	15.41	5.43	16.96

$$\frac{4.74 \text{ Events}}{0.21 \times 10^{-3} \text{ pb}^{-1}} = 22571 \text{ pb}$$

- Our result at 0.8 TeV
- ✓ 25135 pb



Setting Limits

- To calculate limit on new particle cross section we use a binned likelihood by the Bayesian approach.

$$L = \prod_i \frac{\mu_i^{n_i} e^{-\mu_i}}{n_i!}$$
$$\mu_i = \alpha N_i(S) + N_i(B).$$

Measured # of events in data # of event from signal Expected # of event from background

The diagram illustrates the decomposition of the expected number of events μ_i . It shows two equations: the first is the likelihood function L as a product over bins i of the ratio of the measured number of events $n_i!$ to the expected number of events $\mu_i^{n_i} e^{-\mu_i}$; the second equation defines μ_i as the sum of a signal component $\alpha N_i(S)$ and a background component $N_i(B)$. Three arrows point from the terms in the likelihood equation to their corresponding definitions: one arrow points from $n_i!$ to "Measured # of events in data", another from $\mu_i^{n_i}$ to "# of event from signal", and a third from $e^{-\mu_i}$ to "Expected # of event from background".

- The signal comes from our dijet resonance shapes for q^* .
- The background comes from fit.